REMARKS

Claims 1 through 87 are rejected. Claims 1-3, 5, 9-10, 12-13, 15, 21, 39, 48-49, 51-52, 56, 58-59, 68, 72, 83, and 86-87 are amended herein. Support for all amendments can be found in the specification as originally filed. No new matter is believed added by this amendment. Applicants respectfully request reconsideration and further examination of the pending claims in view of the arguments presented herein and in accordance with 37 CFR §1.112.

Objections

The Examiner has objected to a number of informalities in the specification, drawings and claims. Applicants submit herewith redlined proposed replacement drawings for FIGs. 5 and 13 in response to the Examiners objection. No new matter is believed added and no limiting is intended by this clarifying amendment. Applicants respectfully request that the drawing objections be removed. Formal drawings will be provided upon indication of the Examiner's approval of the proposed drawing changes.

The specification has been amended as requested by the Examiner (by adding a separate sheet for the Abstract and by amending pages 24 and 25). No new matter is believed added and no limiting is intended by this clarifying amendment. Applicants respectfully request that the specification objections be removed.

Where appropriate, each of the Examiner's objections to the claims has been addressed by making the requested change. However, Applicants respectfully assert that the British spelling of the term "analyser" is acceptable. For example, see the Miriam Webster Online Dictionary indicating that the term "analyse" is a British variant of "analyze". Applicants respectfully assert that the claims as presented are sufficiently definite to those skilled in the art. Other corrections requested by the Examiner have been made in order to advance the case. No new matter is believed added and no limiting is intended by this clarifying amendment. Applicants respectfully request that the claim objections be removed.

Rejections Under 35 USC § 102

The Examiner has rejected a number of pending claims as anticipated by a number of different references. In particular, the Examiner states that claims 1, 3, 4, 11, 12, 41 through 45, 47 and 85 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,469,520 ("Morey"); claims 1, 2, 5, 6, 17, 18, 22, 39, 86 and 87 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,748,312 ("Kersey"); and claims 1, 2, 9, 13 through 17, 19, 21, 23, 24, 34 through 38, 49 through 56 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6, 204,920 ("Ellerbrock").

Applicants respectfully traverse these grounds of rejection. In general, Applicants respectfully assert that the Examiner has misconstrued the teachings of each of the references, pointing to various Bragg filters and fibres as relating to Applicant's invention. Applicants are not claiming to have invented Bragg filters or optical fibres; instead, Applicants have invented a new "optical spectrum analyser" having a particular type of "tunable optical filter". The Examiner appears to ignore these claimed features. Each of the claims are patentable over the cited references, alone or in combination.

(a) The claims are not anticipated by the Morey reference.

The Examiner rejects a number of claims, including claim 1, as anticipated by the Morey reference. Applicants respectfully traverse this ground of rejection.

The Morey reference generally relates to a "compression tuned fiber grating" or a "tunable reflective element" as shown in FIGs. 1, 3 and 4. FIG. 1 of Morey shows an experimental set up which may be used to interrogate the reflective element, grating 26, in the compression device 90 to thereby prove that the grating wavelength has been tuned as a result of the application of a compressive force. The compression device 90 is controlled by a stepper motor 98 and stepper motor drive circuit 104.

The grating 25 is illuminated by a broadband optical signal 12, 22 generated by an optical source 10, the optical signal 12 being routed to the grating 26 through an optical isolator 50 and a 2x2 optical coupler 18. The coupler 18 splits the optical signal 12 into two optical signals 22, 46. Optical signal 22 is incident on the grating 26 and gives rise to a reflected optical signal 28. The reflected optical signal 28 returns through the coupler 18, via port 35, and along fibre 36 to the spectrum analyzer 38. The spectrum analyzer 38 analyzes the reflected optical signal 28 to determine the wavelengths present within the optical signal 28, to thereby indicate the spectral profile in reflection of the grating 26. This shows whether the resonant wavelength of the grating 26 has changed (i.e., has been tuned) as a result of the applied compressive force.

The spectrum analyzer 38 shown in FIG. 1 of the Morey reference analyzes the optical spectrum of the reflected optical signal 28. The spectrum analyzer 38 is therefore an "optical spectrum analyzer" (OSA). A skilled practitioner would readily appreciate that the spectrum analyzer 38 of the Morey reference is an OSA. An OSA is a standard piece of laboratory equipment. The present application references such standard OSA's as prior art at page 1, paragraph 4. Morey gives no details regarding the configuration or operation of the spectrum analyzer 38 in FIG. 1, and Applicants, therefore, assume that the spectrum analyzer 38 is a standard OSA.

Claim 1 recites an optical spectrum analyser which is well-suited for field monitoring of optical systems and which is inexpensive. The optical spectrum analyser of the present invention, as recited in claim 1, includes a length of optical fibre for receiving an input optical signal, a tunable optical filter including a first in-fibre Bragg grating inscribed in a first section of fibre, and means to apply a variable axial force to the first section of fibre, to thereby tune the peak wavelength of the grating over a desired wavelength range, and an optical detection means. This claimed optical spectrum analyser could, for example, directly replace the OSA 38 of Morey. Since Morey provides no details of the operation of the OSA 38, Morey cannot anticipate embodiments of the present invention. Morey does describe an experimental setup which is used to interrogate the reflective element (grating 26) to prove that the grating wavelength has been tuned as a result of the application of a compressive force.

Such a setup is not an optical spectrum analyser as claimed in claim 1. There is simply no teaching or suggestion in the Morey reference to provide an optical spectrum analyser having the claimed configuration. Further, the general principles disclosed in Morey relating to Bragg filters expressly teach away from the tunable optical filter of the present invention. Morey describes a compression tuned grating and expressly notes that strain tuning is undesirable.

Each of the dependent claims (including claims 3, 4, 11, 12, 41-45, 47 and 85) are patentable at least as depending from a patentable base claim. Claim 87 is believed patentable for similar reasons.

(b) The claims are not anticipated by the Kersey reference.

The Kersey reference fails to teach or suggest embodiments of the claimed invention. Applicants respectfully assert that the Examiner is misreading the Kersey reference. Like Morey, Kersey does not describe an optical spectrum analyser. Instead, Kersey describes an apparatus and method for detecting strain between two fibre Bragg gratings. This is made clear in FIGs. 4 and 5, where peak detectors 52, 68 are shown. The length of optical fibre 22 referenced by the Examiner is for detecting strain. An apparatus for detecting strain between two fibre Bragg gratings is not an optical spectrum analyser. Again, like Morey, embodiments of the present invention could be used with the Kersey reference. For example, an optical spectrum analyser such as the analyser recited in claim 1 could be used to interrogate the optical signals returned from the strain sensor of Kersey. For example, the signals reflected from the FBGs of Kersey could be input into the optical spectrum analyser of the present invention.

The optical signal 32 referenced by the Examiner is not an input optical signal, instead, it is an illuminating optical signal used to illuminate the FBG strain sensors (labeled as FBG_{1-N}). Illuminating optical signals are not input optical signals. Further, the Kersey reference simply fails to teach or suggest any tunable optical filter as recited by claim 1 of the present invention (for good reason – there is simply no need to filter the optical signal reflected from Kersey's strain sensor). The filters 38, 64, and 86 shown in FIGS. 3, 5 and 6 are not tunable optical filters. For example, the optical filter 38 of FIG. 3 is described at col. 5, lines 14-18 as being a

conventional (i.e., bulk-optic) tunable filter. The optical filter 64 of FIG. 5 is described at col. 9, lines 13-14 as being a conventional filter such as a Fabry-Perot filter (again, a bulk-optic device). Similarly, filter 86 of FIG. 6 is clearly labeled as a Fabry-Perot filter. None of these filters are optical fibre devices and none of them include any in-fibre Bragg gratings as recited in claim 1. As such, none are tunable optical filters as recited in claim 1.

At least because Kersey fails to teach or suggest an optical spectrum analyser as recited in claim 1 (and further because Kersey fails to teach or suggest the use of the claimed tunable optical filters of claim 1), Kersey fails to anticipate embodiments as recited in claim 1. Further, there is simply no teaching or suggestion in Kersey to modify the Kersey device to provide the claimed features. Claims depending from claim 1 are believed patentable at least as depending from a patentable base claim.

Claim 87 is believed patentable for similar reasons.

(c) The claims are not anticipated by the Ellerbrock reference.

Applicants respectfully assert that the claims are patentable over the Ellerbrock reference. Like Morey and Kersey, the Ellerbrock reference fails to teach or suggest an optical spectrum analyser. Instead, Ellerbrock describes an optical fiber sensor system (200). The Examiner refers to item 208 (which is a length of optical fibre). However, Applicants respectfully note that the Examiner has misconstrued the purpose of this length of fibre as receiving an "input optical signal" as recited in claim 1. This is incorrect. The "input signal" referred to in claim 1 corresponds to one of the reflected optical signals returned from the sensor arrays (202) of Ellerbrock. However, the fibre Bragg gratings within the sensor arrays (202) of Ellerbrock are strain and/or temperature sensors. They do not form any part of a tuneable optical filter (as recited in claim 1). Quite the contrary – the sensor system illustrated in the Ellerbrock reference has no requirement for a tunable optical filter on the detection side of the system, because the illuminating optical signal is generated by a tunable narrow band of light (light source 204). At least for this reason, claim 1 (and claims depending therefrom) are patentable over the Ellerbrock reference.

Further, the sensor systems described in Ellerbrock do not include any means operable to apply a variable axial force to any of the fibre Bragg gratings within the sensor arrays (202), because the gratings are for sensing strain within a component (e.g., such as a bridge or an aircraft body). That is, Ellerbrock further fails to teach or suggest embodiments of the claimed invention because it lacks the claimed means to apply a variable force ... to thereby tune the peak wavelength of the grating...

Claim 1, and claims depending therefrom, are patentable over the Ellerbrock for at least these reasons. Claim 87 is patentable for similar reasons.

Rejections Under 35 USC § 103

The Examiner has rejected a number of claims as obvious over various references. Claims 25, 28, 29, 31 through 33, 40 57 through 63, 65, 67 through 69 and 82 through 84 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Ellerbrock et al. Claims 26, 27, 30, 64, 66 and 80 are rejected as being unpatentable over Ellerbrock et al. in view of U.S. Patent No. 5,706,375 ("Mihailov et al."). Claims 70 through 79, and 81 are rejected as being unpatentable over Ellerbrock et al. and Mihailov et al. as applied to claims 1, 2, 9, 13 through 17, 19, 21, 23 through 38, 40, 49 through 63, 65 through 69 and 82 above, and further in view of U.S. Patent No. 5,982,962 ("Koops et al."). Claims 7 and 8 as being unpatentable over Kersey et al. in view of Koops et al. Claim 10 is rejected as being unpatentable over Morey et al. Claims 46 and 48 are rejected as being unpatentble over Morey et al. in view of U.S. Patent No. 5,694,501 ("Alavie et al.").

As an initial matter, Applicants respectfully assert that each of the claims is patentable over the references at least as described above.

Regarding the rejection of claim 25 over Ellerbrock, Applicants respectfully assert that Ellerbrock fails to teach, suggest, or render obvious an optical spectrum analyser having the particular arrangement of two optical fibre couplers and two optical detectors as recited in claim 25. The Examiner points to the Ellerbrock's photodetector and "another detector (334 or 336)"

as, apparently, being equivalent to Applicant's two optical detectors. Applicants respectfully traverse this ground of rejection. The "other detector" is clearly an electrical device (i.e., it does not receive an input optical signal). The Examiner seems to be of the opinion that all that the photodetectors of claim 25 etc. do is to detect the peak wavelength reflected by one of the gratingsin the tunable optical filter. Applicants remind the Examiner that the reflectivity of a reference grating varies as a function of the wavelength across its spectral bandwidth. It is the optical power of the optical signal reflected from a reference grating that indicates the wavelength of an optical signal, and it is the ratio of the optical powers detected by the first and second photodetectors that is indicative of the detected optical signal. It simply is not a simple matter of "design choice" as suggested by the Examiner, to arrive at the configuration of claim 25. It is a huge leap from the configuration of Ellerbrock to the present invention. Applicants respectfully request that the §103 rejection be removed. Claim 25, and the other claims rejected on this ground, are patentable over the Ellerbrock reference.

Regarding the rejection of claims 26 etc. under §103 over Ellerbrock in view of Mihailov, Applicants respectfully traverse the rejection. Mihailov describes a variable-attenuation optical router, not an optical spectrum analyser. An optical router does not function like an optical spectrum analyser, and could not be used in place of an optical spectrum analyser. As such, a skilled practitioner would not find it obvious (or practical) to combine Ellerbrock and Mihailov. Notwithstanding this, however, if a practitioner somehow did choose to combine the two devices, she would not arrive at the present invention as recited in claims 26,etc. For example, if, as suggested by the Examiner, the Bragg gratings of Ellerbrock were replaced with chirped Bragg gratings, the resulting system would be an optical fibre sensor system in which the spectral responses of the gratings would be quite broad, thereby making it difficult (if not impracticable) to determine the resonant wavelength of each grating (and thus the amount of strain and/or temperature it was sensing). The use of chirped gratings would also mean a much broader operating bandwidth was required for each grating within a sensor array, resulting in a significantly reduced number of gratings being able to be illuminated with an optical source of a fixed bandwidth. For these, and similar reasons, a skilled person generally does not use chirped gratings as sensors. For these (and other) reasons, claims 26 etc. are not rendered obvious by the cited references.

Regarding the rejection under §103 over Ellerbrock, Mihailov and Koops, Applicants again respectfully assert that the cited references do not render the claimed invention obvious. Neither Ellerbrock, nor Mihailov disclose an optical spectrum analyser including optical calibration apparatus as recited in claim 70 (further, they do not even mention the need for any calibration apparatus of any kind). Koops, like Ellerbrock and Mihailov, fails to teach an optical spectrum analyser (and, at least for this reason, the claims are patentable over the cited combination).

Koops describes WDM devices. A WDM is not the same as a coupler, nor are they interchangeable (as suggested by the Examiner). In particular, Applicants respectfully assert that the WDM of Koops is not interchangeable with the couplers described in Ellerbrock. Each "signal splitting device" has substantially different characteristics, preventing them from being readily interchangeable as suggested by the Examiner. Claims 70-79 and 81 are patentable over the cited references.

Regarding the rejection of claims 7 and 8 under §103 over Kersey in view of Koops, Applicants respectfully traverse. Again, neither Koops nor Kersey teach or suggest the use of an optical spectrum analyser (much less an optical spectrum analyser as clearly recited in claim 1 from which claims 7 and 8 depend). Further, the wavelengths referenced by the Examiner at col. 6, lines 46-49 of Koops do not refer to any wavelength tuning range as recited in claims 7 and 8. The section of Koops referenced by the Examiner relates to a situation where the microlens coupling arrangement is used in connection with coupling the pump light into an M-fiber laser. The pump light being for amplifying the laser light (at a different wavelength, 1550nm) propagating within the core of the M-profile optical fibre. A skilled practitioner would appreciate that the pump light of a laser has a different wavelength to the lasing wavelength of the laser. That is, the two wavelengths mentioned at the section referenced by the Examiner do not represent a tuning range. This makes sense, because the references cited by the Examiner simply do not relate to optical spectrum analysers. Claims 7 and 8 are patentable over the cited references.

Regarding the rejection of claim 10 under §103 over Morey, Applicants again respectfully traverse. The Examiner asserts that the grating of Morey is subject to strain and therefore has a suppression ratio. Applicants strongly disagree and assert that this represents an incorrect understanding of what is meant by the term "side-lobe suppression ratio." The spectral profile of a Bragg grating has a central resonance peak (of the general shape shown in FIGs. 2, 7 and 8) and, due to the structure of the grating, will generally also have resonance peaks of much lower reflectivity on either side of the resonance peak – these are known as side-lobes. In the present invention, the presence of side-lobes is undesirable. During fabrication of the gratings, the side-lobes are suppressed. The amount of suppression is described by stating the side-lobe suppression ratio. No such suppression is described by Morey. Because such suppression is not taught or suggested by Morey, it certainly would not have been obvious to provide the suppression ratio of greater than approximately –20dB as recited in claim 10. Claim 10 is patentable over the cited references.

Regarding the rejection of claims 46 and 48 under §103 over Morey in view of Alavie, Applicants again respectfully traverse. As discussed above, Morey fails to teach or suggest an optical spectrum analyser as recited in the present claims. Alavie also fails to teach or suggest such an optical spectrum analyser. Instead, Alavie describes a method for controlling the amount of strain applied along the length of a grating, to thereby enable the spectral profile of the grating to be altered by changing the applied strain. Morey expressly teaches away from applying strain, and instead expressly states that compression tuning is desirable. There is simply no motivation or suggestion to make the combination asserted by the Examiner. Claims 46 and 48 are patentable over the cited references.

CONCLUSION

In view of the above, each the pending claims are patentable over the cited references, alone or in any combination. Applicants respectfully request allowance of the pending claims.

Applicants' silence with respect to other comments made in the Office Action (e.g., comments directed to various dependent claims) does not imply agreement with those comments.

Applicants hereby request a 2-month extension of time. The $210 fee pursuant to 37 CFR 1.17(a) is included herein. The commissioner is hereby authorized to charge deposit account no. 50-1852 for any additional fees that may be due in conjunction with this matter.

If any issues remain, or if the Examiner has any further suggestions for expediting allowance of the present application, the Examiner is kindly invited to contact Kurt M. Maschoff using the information provided below.

Respectfully submitted,

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Date

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Encl. Red-lined drawing changes to FIGs. 5 and 16